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25 COLUSA IRRIGATION DISTRICT, et al.

26 UNITED STATES DISTRICT COURT

27 EASTERN DISTRICT OF CALIFORNIA, FRESNO DIVISION

28 PACIFIC COAST FEDERATION OF
FISHERMEN'S ASSOCIATIONS, *et al.*,
Plaintiffs,
v.

GINA RAIMONDO, *et al.*,
Defendants.

Case No. 1:20-cv-00431-JLT-EPG
Case No. 1:20-cv-00426-JLT-EPG

29 DECLARATION OF JOEL KIMMELSHUE
IN SUPPORT OF SACRAMENTO RIVER
INTERVENORS' OBJECTION TO
INTERIM OPERATIONS PLAN
EXTENSION

Date: TBD
Time: TBD
Dept. 5
Judge: Jennifer L. Thurston

30 Date Action Filed: February 20, 2020

1

DECLARATION OF JOEL KIMMELSHUE

2 I, JOEL KIMMELSHUE, declare that the following facts are true and correct and/or are
3 based on my expert opinions:

4 1. I am a Principal Agricultural Scientist, as well as owner, of Land IQ, LLC. I
5 received a Bachelor of Science in Soil Science from California Polytechnic State University, San
6 Luis Obispo and a Master of Science and Doctor of Philosophy in Soil Science with an emphasis
7 on Agricultural Engineering and Agricultural Water Resources Management from North Carolina
8 State University. Since 1996, I have worked as a consulting agricultural scientist in the technical
9 areas of land use classification, crop consumptive water use, agricultural production systems,
10 agricultural water quality suitability, land use change interpretation, regulatory compliance, and
11 other objective scientific applications to irrigated agricultural production. My qualifications to
12 render opinions in this matter are set forth in my curriculum vitae attached hereto as Exhibit A and
13 incorporated herein by reference.

14 2. I am hereby providing expert opinions and testimony on behalf of Intervenor-
15 Defendants the Sacramento River Settlement Contractors (“SRSC”) and the Tehama-Colusa Canal
16 Authority (“TCCA”), who are collectively referred to as the “Sacramento River Intervenors” in
17 this proceeding. The expert testimony I will provide addresses acres of planted rice in California
18 and specifically in the Sacramento Valley within the Sacramento River Intervenors production
19 areas. In my opinion, it is clear that the lack of water available to the Sacramento River
20 Intervenors has significantly reduced the acreage of rice specifically within these areas as
21 compared to areas outside of the SRSC and TCCA which have remained consistent in planted
22 acreage.

23 Rice Production in California

24 3. Rice has been produced in California since the early 1900s. (UC-ANR. 2022) It is
25 primarily produced within a defined area in the Sacramento Valley along the west and east sides of
26 the Sacramento River and adjacent/tributary rivers including the Feather and Yuba rivers. Much
27 smaller acreages of rice are produced in the Sacramento/San Joaquin Delta and the northern San
28 Joaquin Valley. The soils, topography, climate, water supply, and developed infrastructure make

1 for ideal conditions for rice production in the Sacramento Valley. As such, a premium quality,
2 medium-grained rice is primarily produced there, and is marketed and sold both domestically and
3 globally.

4 **Rice Mapping Background, Development, and Approach**

5 4. I have developed and led a team of objective scientists over the past 10 years
6 specifically in the area of field-by-field spatial mapping of crops throughout California and select
7 areas of over a dozen other states, and the countries of Mexico and Australia. Historically, this
8 work began as a statewide crop mapping effort for the Almond Board of California, the Walnut
9 Board of California, the California Prune Board, and the California Pistachio Research Board.
10 Beginning in 2014, an interest among a number of rice marketing entities developed for which I
11 led a team in the effort to individually map both conventional and wild rice fields statewide. This
12 work is conducted every year during the growing season with mapping results delivered in late
13 June and again in late July. The information is used by various rice marketing and other rice
14 industry interests for the purposes of not only understanding the numerical acreage of rice, but
15 more importantly, the spatial location of every rice field in production in the state of California.
16 Also, since 2014 Land IQ now maps every agricultural field in California that is approximately 2-
17 acres and greater for the California Department of Water Resources in response to the
18 requirements of the Sustainable Groundwater Management Act. Specialized mapping is also
19 conducted for the same commodity groups mentioned above as well as the California Avocado
20 Commission, the California Blueberry Commission, the American Pecan Council, and various
21 other state, national, and international commodity organizations.

22 5. The approach used to map rice and wild rice in California consists of a series of
23 steps. Over the past 10 years a master base layer of potential rice areas has been established. This
24 base layer contains any field 2-acres and greater that has ever been planted to rice. The layer is
25 updated each year to add any newly established rice fields. Next, an analysis of a 2-3-month series
26 of satellite imagery, taken as frequently as every 5-6 days, is conducted to detect the
27 characteristics of rice production, before, during and immediately after planting season. Once rice
28 fields are identified, a comprehensive ground truthing effort is conducted by Land IQ staff within

1 rice growing areas to independently observe rice, fallow, or other cropped fields. 1,200-1,400
2 fields (rice, fallow, other crop) are logged each year during this ground truthing event. Lastly, a
3 comparison is made between the observed rice, fallow, and other cropped fields versus that
4 predicted during the in-office analysis efforts. As a result of the comparison, the average spatial
5 accuracy of rice, fallow, and other crop fields is 98-99% depending on the year.

6 **Historical Mapping of Rice in California**

7 6. Since 2014, I have led a team at Land IQ that has been providing an initial (late
8 June) and final (late July) rice acreage estimate for the entirety of California. Most of the rice is
9 produced in the Sacramento Valley, with small acreages in northern San Joaquin counties, and a
10 steadily increasing acreage in the Sacramento/San Joaquin Delta. Speculation has occurred over
11 time that permanent tree crop plantings have taken over previously planted rice ground. This has
12 occurred in some outer fringe areas, however not to a significant degree. Alternatively, and albeit
13 minor, each year some new rice fields are discovered. Therefore, the available footprint for rice
14 production, specifically in the Sacramento Valley has remained relatively constant. From 2014
15 through 2021, the average area planted to rice has been approximately 471,000 acres (Figure 1).
16 The range has been 405,662 acres in 2021 to 541,767 acres in 2016. In 2022, the total acreage of
17 rice planted in California was 252,980 acres; approximately 54% of the long-term average.

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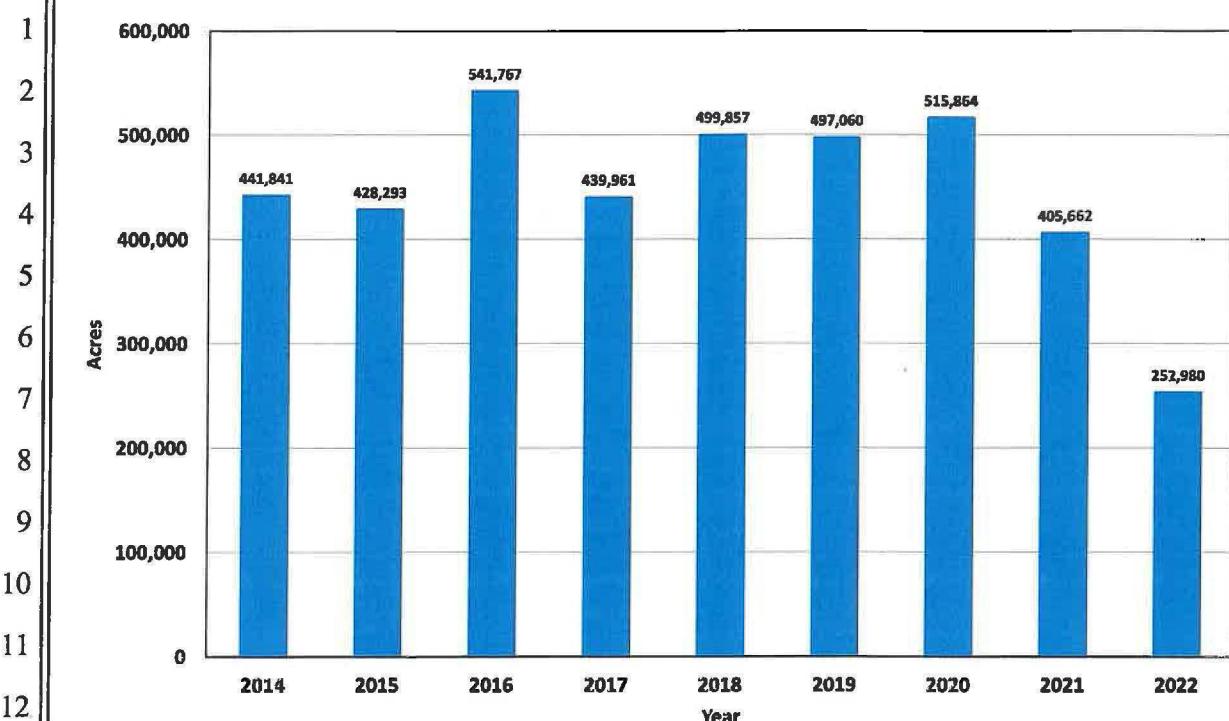


Figure 1. Historical rice acreage in California (2014-2022).

A Comparison of Rice Mapping in 2021 and 2022

7. The 2022 planted rice acreage was significantly less than any other prior year mapped by Land IQ or as reported by the United States Department of Agriculture, National Agricultural Statistic Service for any year prior to 2014. (USDA-NASS, 2022) As noted previously, the statewide area planted to rice in 2021 was 405,662 acres. The area planted in 2022 was 252,980 acres. While this reduction in planted acreage is significant, it is even more telling where the fallowing took place. The benefit of spatial mapping allows for the correlation to unique areas. The fallowing of traditionally planted rice ground between 2021 and 2022 did not occur uniformly across the entire Sacramento Valley. Rather, most of the fallowing occurred within the areas served by Sacramento River Intervenors. This is clearly evident when viewing the spatial mapping of rice within the Sacramento Valley (Figures 2 and 3). Numerically, a 155,925-acre reduction, or 82%, in planting occurred within the Sacramento River Intervenors area as compared to 2021. Conversely, an increase in rice planting of 3,242 acres occurred within all areas outside of SRSC and TCCA between 2021 and 2022 (Table 1).

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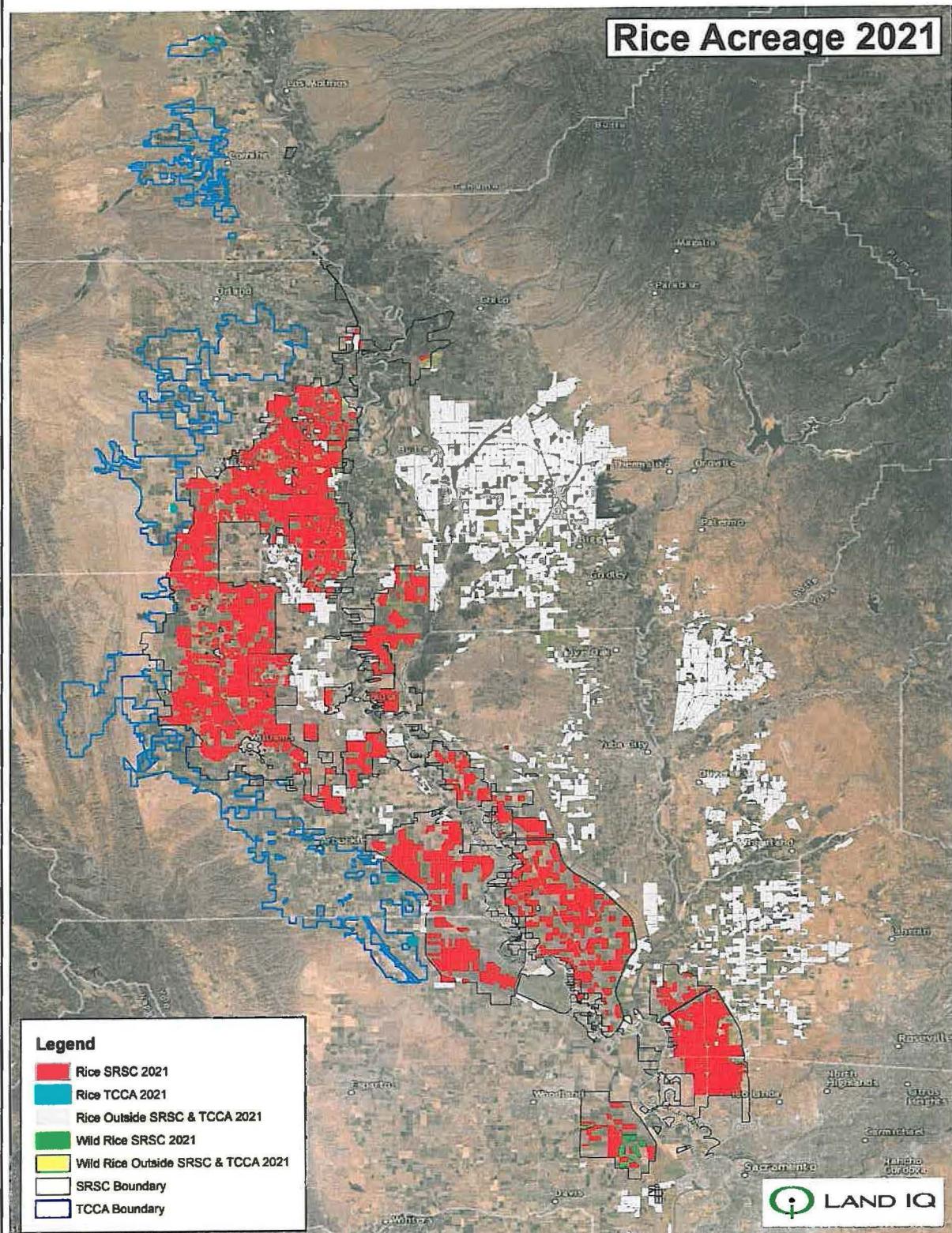


Figure 2. 2021 Rice production in the Sacramento Valley within SRSC, TCCA, and areas outside.

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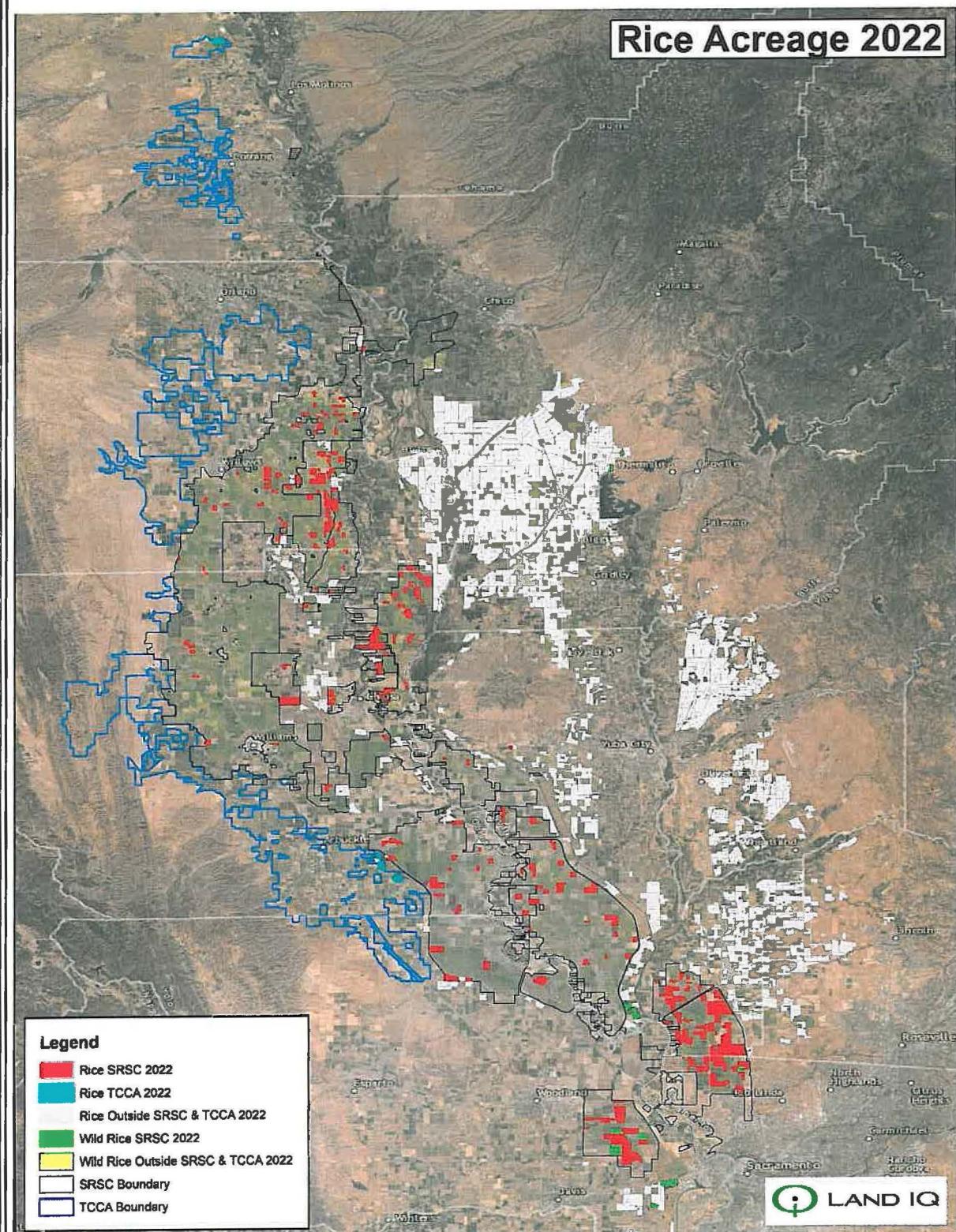


Figure 3. 2021 rice production in the Sacramento Valley within SRSC, TCCA, and areas outside.

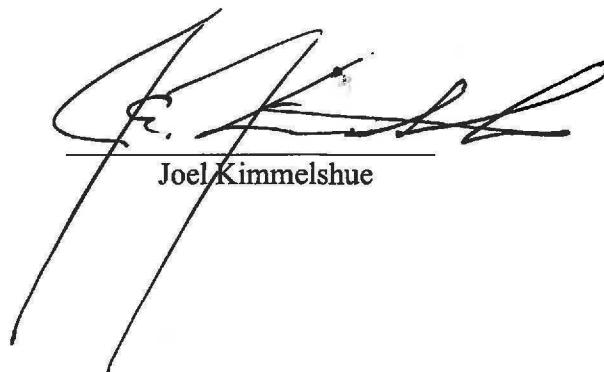
1 Table 1. 2021/2022 numerical rice acreage comparison for SRSC, TCCA, and areas outside.

	2021	2022	Difference
SRSC	190,740	34,856	-155,884
TCCA	389	348	-41
Outside	214,534	217,776	3,242
Total	405,662	252,980	-152,682

6 **Reduced Water Availability on the West Side of the Sacramento Valley Has Resulted
in Significant Reductions in Rice Planting**

8. The reduction in water availability on the west side of the Sacramento Valley,
9 specifically the Sacramento River Intervenors service area, has resulted in significant fallowing of
10 ground not experienced since the development of modern irrigated agricultural systems within this
11 geography. This is most noticeable with rice production, however also in other annual crops
12 commonly grown within the Sacramento River Intervenor area including tomatoes, sunflowers,
13 seed crops, and other irrigated annuals.

14 I declare under penalty of perjury under the laws of the State of California that the
15 foregoing is true and correct. Executed this 28 th day of October, 2022, in Sacramento, California.


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17 Joel Kimmelshue
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EXHIBIT A

**Joel Kimmelshue, PhD, CPSS,
Principal Agricultural Scientist**



Education

Ph.D., Soil Science (Water Resources concentration), North Carolina State Univ., Raleigh, 1996
M.S., Soil Science (Ag Engineering concentration), North Carolina State Univ., Raleigh, 1992
B.S., Soil Science (Crop Sci. concentration), California Polytechnic State Univ., San Luis Obispo, 1990

Professional Registrations and Organizations

Certified Professional Soil Scientist (CPSS - #18204) – American Registry of Certified Professionals in Agronomy, Crops and Soils; American Society of Agronomy; Soil Science Society of America

Distinguishing Qualifications

Expert/Specialist in the following areas:

- Land use assessments and crop identification
- Production agricultural systems
- Soil/water/plant relations in arid climates
- Irrigation and drainage management
- Crop consumptive use estimates
- Expert witness testimony
- Soil and land use evaluations for the implementation of irrigation systems and crop production
- Water resources
- Soil nutrient interactions and environmental issues in soils
- Agricultural land application and reuse systems for various liquid and solid byproducts
- Soil and water salinity management for agriculture
- Dust and Erosion Control
- Water quality for irrigated agriculture
- Regulatory support and negotiation for agriculture
- Policy, regulatory, and environmental influences on agricultural production systems
- Soil and water conservation
- Agricultural research

Relevant Experience

Dr. Kimmelshue is a Principal Soil and Agricultural Scientist for Land IQ. Dr. Kimmelshue is also a founding Owner in the firm. He has experience in agricultural and water resources consulting in the western United States (especially California), and agricultural research and crop production throughout the United States. This experience stretches to various locations in Europe and the Middle East. Dr. Kimmelshue has performed technical leadership and/or managed numerous projects and tasks of nearly \$25 million dollars over the past 25 years.

Dr. Kimmelshue's consulting experience includes practical and applied solutions for development of water/soil management systems and agricultural systems, specifically with irrigated agriculture. This

technical expertise also includes expert witness testimony, crop consumptive use estimates, erosion and dust control, regulatory support and negotiation, water resources science and planning, land reclamation, soil/plant nutrient dynamics, irrigation and drainage in arid and humid climates, soil classification, crop production, land application of municipal and agricultural wastes, and revegetation/reclamation efforts.

Predominantly, the objective scientific work that Dr. Kimmelshue performs is driven by ever-changing policy, legislative and environmental pressures on production agricultural systems. Dr. Kimmelshue thoroughly understands these drivers and applies sound scientific results to help his clients address these challenges.

Select Representative Projects – Domestic

(Complete work experience includes efforts in the states of: Alabama, Arizona, California, Colorado, Florida, Georgia, Idaho, Iowa, Louisiana, Montana, Nevada, New Mexico, North Carolina, Oklahoma, Oregon, Texas, Utah, Washington, and Wisconsin.)

LAND USE MAPPING

- **Principal in Charge and Technical Lead – Statewide Rice and Wild Rice Acreage Mapping – Various Rice Interests and the California Wild Rice Advisory Board.** Since 2014 during the growing season for various rice interests, industry representatives, and the California Wild Rice Advisory Board, Dr. Kimmelshue leads a technical team in mapping conventional and wild rice statewide although primarily in northern California. The mapping is highly accurate (>99%) in most years. The work consists of maintaining and updating a base rice acreage potential production layer, a multi-image temporal classification, and intensive ground truthing validation efforts.
- **Principal in Charge and Technical Lead – Statewide Crop and Land Use Mapping – California Department of Water Resources.** Land IQ is contracted by the state of California to conduct statewide crop mapping of approximately 50 different crop types on over 9.4 million acres of agricultural land for fields of 2.0 acres and larger (sometimes smaller depending on crop type – (e.g. avocados)). The entire dataset amounted to over 350,000 individual polygons and an average field size of 34 acres. The mapping spanned the entire state from the Mexico, Nevada, and Arizona borders to the Pacific Ocean. The ultimate accuracy of the 2014 mapping based on thousands of miles of ground truthing was 96.6%. The 2020 statewide accuracy was 98%. Land IQ is now mapping multi-cropping systems throughout the state in addition to the main season cropping systems.
- **Principal in Charge and Technical Lead – Nationwide Mapping of Pecans – American Pecan Council.** As a result of successful mapping of various other tree crops for multiple years primarily in California, the American Pecan Council contracted with Land IQ to map pecans nationwide. This ongoing project spans the states of California, Arizona, New Mexico, Texas, Oklahoma, Louisiana, Alabama, and Georgia. The mapping years currently are for 2017 and 2018 and also contain an orchard by orchard age analysis. The orchards are mostly classified as improved or organized plantings, however some of the pecan production consists of native areas. Applications of these efforts also focus on the impact of Hurricane Michael on losses of orchards in Georgia in late 2018.
- **Principal in Charge and Technical Lead – Statewide Avocado Mapping – California Avocado Commission.** For the California Avocado Commission, Dr. Kimmelshue leads a technical team in mapping avocados statewide although primarily in southern California. The mapping is highly accurate (>97%) and ranges down to fields of 0.5 acres. The California avocado industry is a

relatively small in the global market, however produces high quality fruit for a premium price. The purpose of this annual mapping is to always be aware of not only the number of acres in production for also the condition of each orchard (e.g. producing, young, stumped, abandoned).

- **Principal In Charge/Technical Specialist – Statewide Spatial Mapping of Almonds, Walnuts, Pistachios, and Dried Plums; Almond Board of California, California Walnut Commission, California Pistachio Research Board, California Dried Plum Board; Modesto/Sacramento/Fresno, CA.** Dr. Kimmelshue is currently leading an intensive state-wide, field by field mapping product of all almonds, walnuts, pistachios, and dried plums across the entire state of California. Due to the rapid expansion of these tree crops, understanding of actual acres, age, and location in comparison to water sources, environmentally sensitive areas, transportation corridors, other crop types, and many other attributes are increasingly important to these four commodity organizations. The resultant work is a highly accurate, timely, and cost-effective crop mapping product. The technology employed for this work is a combination of inherent agronomic knowledge of cropping systems in California, remotely sensed attributes, and use of multiple additional lines of evidence.
- **Technical Lead–Central Utah Water Resources and Land Classification Project; Central Utah Water Conservancy District; Roosevelt, Utah.** Successfully mapped nearly 10,000 acres of lands slated for supplemental irrigation and drainage improvements. Responsibilities included quality control for soil sampling and data interpretation. Co-authored a report to the USBR for final project approval and certification by the United States Congress.

AGRICULTURAL WATER RESOURCES

- **Principal in Charge and Project Manager – Monthly Remotely Sensed Crop Consumptive Use – Semitropic Water Storage District, North Kern Water Storage District, Shafter Wasco Irrigation District.** As a part of the California Sustainable Groundwater Management Act (SGMA) regulatory requirements, highly accurate and timely evapotranspiration measurement are a key input to hydrologic models and overall efficient water management. For these 3 irrigation districts spanning approximately 400,000 acres, a monthly remotely sensed ET field by field measurement is performed and delivered to the districts within 30 days following the end of the previous month. The results are created with a remotely sensed regression approach that integrates nearly 40 simple ground truthing stations that measure the climatic variables necessary to calculate actual ET. These calibration points are then used in the model to estimate ET from every irrigated and non-irrigated field, as well as native areas. The ground truthing stations are also used for validation datasets.
- **Project Manager and Technical Lead–Cold Water Rice Yield Loss Determination; Western Canal Water District, Richvale Irrigation District, Biggs West Gridley Irrigation District; Cold Water Influences on Rice Yield; Nelson, Richvale, and Gridley, CA.** This project centered on the development and implementation of Settlement Agreement technical protocols between the three Districts (approximately 100,000 acres) and the California Department of Water Resources. The implementation of this Agreement will result in payment by the State of California to the growers within the Districts for loss of rice yield due to cold water diversion from the State Water Project at Oroville Dam and the Thermalito afterbay. The determination of yield loss is being conducted using aerial, satellite and other remote sensing techniques. This approach is being correlated to field measured yield losses utilizing grower owned and operated, combine-equipped GPS yield monitors. Also, in-canal temperature measurements were taken at 125 locations throughout the Districts for a period of up to 90 days. A temperature interpolation map and equation has been developed and is a third method of estimating yield loss determination. These three methods are being correlated

against each other for an ultimate yield loss estimate. This work involves consistent contact and interaction with Districts' managers and staff, representatives from the California Department of Water Resources in Sacramento and Red Bluff, cooperating growers, and sub-consultants.

- **Technical Lead and Project Manager – Kern River Watershed Coalition Authority, Sub Basin Review of Agricultural Irrigation and Drainage Practices and Crop Impacts; Bakersfield, CA.** Dr. Kimmelshue was retained by the KRWCA as an expert in providing sound technical agronomic information related to the unique irrigation and crop production practices of the Kern Sub Basin area within the Southern San Joaquin Valley Water Quality Coalition. This work involved understanding and interpreting changes in cropping patterns, irrigation methods, salinity management, fertilization practices and overall water and nitrogen use efficiency. A portion of this work included intensive ground truthing for development of remotely sensed crop mapping products. Those ground truthing data included permanent crop irrigation method documentation for use in irrigation method change over time.
- **Technical Lead – San Joaquin River Restoration Program, Seepage Management Plan, Expert Review Panel Member; United States Bureau of Reclamation; Sacramento, CA.** Dr. Kimmelshue was retained as a salinity, agricultural production, and irrigation and drainage expert to review a completed current version of the Seepage Management Plan for seepage impacts to agriculture including acceptable water table depths, salinity management, yield decline, remotely sensed solutions and irrigation and drainage management considerations. This work will result in completion of a comprehensive management document offering a review of thresholds, solutions and mitigation opportunities as a result of future increased flows in the San Joaquin River.
- **Project Manager and Technical Lead–Historical and Present Crop Evaluation and Water Use Estimate; Brownstein, Hyatt, Farber, Schreck – Water Law Firm – representing a Confidential Client; Bakersfield, California.** This project involved the historical and present quantification of water use at a confidential site near Bakersfield. Historical remote sensing imagery was acquired to determine the irrigated area changes over time as well as the cropping pattern shifts from the early 1950s to present day. Water use estimates were determined for the current cropping patterns as well as diverted water quantities. A comprehensive site evaluation was performed with the client and area grower/owner to determine soil type, water conveyance, irrigation methods and management, storage, crop types, etc. This work was used to facilitate a potential substantial land purchase and water rights quantification.
- **Expert Witness and Technical Lead–Prepared Testimony for United States District Court – Eastern District of California; Judge Oliver W. Wanger; Tehama Colusa Canal Authority Water Deficit Evaluation; Willows and Fresno California.** Dr. Kimmelshue was retained to prepare a detailed evaluation of the influence of regulated deficit irrigation on a variety of crops including almonds, grapes, walnuts, rice, olives, alfalfa, tomatoes and a variety of other permanent and annual field and row crops. The preparation of this testimony was conducted to determine the influence of a deficit of irrigation water at predetermined periods of the growth cycles of the crops mentioned above – predominantly focusing on perennial crops such as almonds. The results of this work indicate the extreme detrimental influence of insufficient irrigation during key growth stages of the crop.
- **Expert Witness and Technical Lead–Prepared Testimony for Santa Clara County Superior Court; Judge Jack Komar; Crop Water Demand and Estimation of Return Flows in Irrigated and Nonirrigated Areas; Southern California Water Company; Santa Maria, California.** This project involved expert witness testimony, both in deposition and in trial settings, based on an 8-month effort to assess crop water use for an historical 58-year period over a 164,000-acre basin. The work

focused on pumped water and return flows to groundwater under irrigated and nonirrigated areas. Crop and native vegetation evapotranspiration and soil storage modeling was conducted. Water was assessed to ensure adequate quality for sensitive crop production. The expert witness testimony included 2 days of deposition and 2 additional days of trial testimony, including cross-examination. The work was conducted as a component of a groundwater basin assessment focusing on the potential for overdraft. This was a multi-stakeholder case, which included agricultural, urban and local, state, and federal agencies.

- **Expert Witness and Technical Lead—Preparing Testimony for Los Angeles County Superior Court; Judge Jack Komar; Crop Water Demand and Estimation of Return Flows in Irrigated and Non-irrigated Areas; Antelope Valley Groundwater Agreement Association; Lancaster, California.** This work centered on the quantification of a water right adjudication of the Antelope Valley. Dr. Kimmelshue represented the agricultural interests in the Valley and conducted a detailed and comprehensive assessment of crop water use, irrigation methods and efficiencies, return flows, and other parameters to ultimately assess a component of the safe yield of the groundwater basin based on agricultural pumping. This work was prepared for expert witness testimony in early 2011. Modeling was conducted to assess not only a variety of crop types in irrigated agricultural, but also irrigated urban areas.
- **Technical Lead and Task Manager—Blackfeet Indian Reservation Water Right Adjudication; Bureau of Indian Affairs/Department of Justice; Browning, Montana.** Technical expert since 1997 leading efforts related to the establishment of a water rights claim for the Blackfeet Indian Tribe. These efforts have and continue to include determination of practicably irrigable acres, detailed land classification for the determination of arable and irrigable lands, present and historical irrigation delineations, water demand estimates of both agricultural and urban uses, drainage evaluations for the purpose of avoiding salinization of lands, and overall task management for nearly \$1.7M of labor, sub consultants, and expenses.
- **Technical Lead—Soil Salinity Evaluation; Glenn Colusa Irrigation District (GCID); Willows, California.** This soil salinity evaluation took place over approximately 200,000 acres of within GCID and some neighboring Districts. Dr. Kimmelshue managed and worked with GCID staff to sample the entire District and adjacent areas for soil salinity within the root zone. Sampling and analysis results were compared with historical measurements by the U. S. Bureau of Reclamation (USBR). The trend of salinization was analyzed for its relationship to long-term irrigation management, including a regulatory drought during which irrigation was curtailed throughout the District.
- **Technical Lead; Water Resources Plan—Oakdale Irrigation District; Oakdale, California.** This effort involved detailed assessment of historical land use and projections for future trends based on agricultural market conditions and urban and environmental pressures. This project also involved the development of a comprehensive water resources planning model. Main inputs to this dynamic model were crop water use estimates, water storage and conveyance, deep percolation, losses, recycled water use, and overall long-term water management options for both agricultural and urban uses.

EROSION CONTROL AND LAND STABILIZATION

- **Technical Specialist – Owens Lake Dust Control; Los Angeles Department of Water and Power; Los Angeles/Lone Pine, CA.** For more than a decade Dr. Kimmelshue has provided senior technical expertise on a large variety of dust control efforts on the Owens Lake Dust Control Project. Historically, this area was one of the largest dust emission sources in the western hemisphere. Over

time, Dr. Kimmelshue has provided objective scientific leadership on development, testing and large-scale (thousands of acres) implementation of various dust control technics and methodologies. These efforts specifically focus on analysis of various environmental conditions including soil type, climate, seasonality of emissions, water quality, and relative land disturbance. Based on those analyses, various methodologies to control source areas and challenging surface emissions in harsh environmental conditions have been achieved. Control methodologies include source control, soil binders, revegetation, shallow flooding and various tillage operations.

- **Principal In Charge/Technical Specialist – Dust Control in Almonds; Almond Board of California/California Department of Food and Agriculture, Modesto/Sacramento, CA.** Dr. Kimmelshue is currently providing senior technical expertise on a state-wide dust control testing project through the Almond Board of California as funded by the California Department of Food and Agriculture Specialty Crop Block Grant Program. This project is being conducted to ascertain the effectiveness of application of MgCl₂ as a dust suppressant in almond production. Different rates of application are being tested to assess relative dust suppression coupled with agronomic suitability and environmental protection. This project began in October of 2012 and will continue through June of 2015. Environmental testing including air emissions and comprehensive soil testing, analysis and interpretation. Expected results include determination of an acceptable range of application rates as related to soil type, irrigation method, and orchard floor management.

REUSE AND LAND APPLICATION/WATER QUALITY

- **Project Manager and Technical Lead–Blending of Saline Mine Water with Central Arizona Project (CAP) Water for Irrigation to Cotton, Alfalfa, and Sod; Rio Tinto Mining Company – Resolution Copper; Superior and Queen Creek, Arizona.** Dr. Kimmelshue is leading an effort to create an acceptable blended water quality for irrigation to alfalfa, cotton and sod on approximately 5,500 acres of land within the New Magma Irrigation and Drainage District (NMID). This project involves direct working efforts with the USBR, the state of Arizona Lands Department, NMID, the University of Arizona Soil, Water and Environmental Science Department, and the Resolution Copper Company. Many of these multi-stakeholder meetings were for the purpose of obtaining permitting documents and satisfying the discharge requirements. The work involves real-time monitoring of treated mine water, CAP water, and the blended result. This monitoring network comprises in-canal Total Dissolved Solids (TDS), temperature, and pH probes. A web-based portal will be used for instantaneous water quality assessment and tracking. Also, a comprehensive soil, water, and tissue sampling program will take place at least quarterly during this 5-6 year project. Crop growth stages and tracking will also be conducted. The dewatering of this mine is necessary to make copper ore available from the largest copper mine in North America.
- **Project Manager and Technical Lead–Irrigation Water Reuse – Water Demand Estimates and Water Quality Suitability; City of Hollister and San Benito County Water District; Hollister, California.** This project involved the quantification of water needs assessment from both a quantity and quality perspective for irrigation with treated wastewater. Dr. Kimmelshue led multiple public education sessions related to the water quality and worked closely with both the City and Water District to ensure acceptance by the farming community. Water quality and quantity estimates were determined and were coupled with appropriate crop types and practices. A key portion of this work involved an update of the Recycled Water Master Plan for approval by the Regional Water Quality Control Board and other entities.

- **Project Manager and Technical Lead–Santa Clara River Watershed Total Maximum Daily Load (TMDL) Collaborative Process; Agricultural Irrigation Thresholds for Chloride and Salinity; Los Angeles County Sanitation Districts; Fillmore, California.** This project included the development of a detailed literature review and evaluation for determination of the potential threshold of irrigation water quality constituents of concern, specifically chloride, on sensitive crops as a basis of a TMDL process in working with the California Regional Water Quality Control Board. This collaborative process included work with a multitude of stakeholders including the California Avocado Commission, the California Strawberry Commission, Nursery Crop Growers, Ventura County Farm Bureau, and Los Angeles County Sanitation Districts. A multitude of crops were evaluated for their individual tolerances to specific constituents of concern. Only the most susceptible crops were further evaluated and included avocados, strawberries, and nursery stock. This work involved detailed assessment of water quality, irrigation practices, cultural practices and drainage management for the overall determination of acceptable irrigation water quality. The work also included comprehensive public notification efforts with stakeholder groups, public officials, researchers, and farm managers. The ultimate outcome of the work has been highly influential in establishing a chloride TMDL for irrigation of sensitive species in the Santa Clara River Basin.
- **Technical Lead–Land Application of Former Fertilizer Processing Solids; ChevronTexaco; Fort Madison, Iowa.** This \$1.2 million project included the land application of fertilizer pond wastewater (1.5 million gallons) and solids (16,000 cubic yards) to approximately 2,200 acres of suitable farmland in Lee County, Iowa. Roles and responsibilities included management of site suitability analysis, pilot testing with Iowa State University, and request for subcontractor proposal development, contract negotiations, and regulatory requirements.
- **Project Manager and Technical Lead–Detailed Nitrogen Balance Model as a Component to a Required Plan of Study (POS); Anheuser-Busch; Jacksonville, Florida.** This POS evaluated the nitrogen dynamics resulting from multiple-year application of brewery processing waters to more than 300 acres of sod grass through center-pivot irrigation systems. Products included the development of a detailed nitrogen balance historical and predictive model for improvement of site irrigation management. An assessment report and findings were presented to the Florida Department of Environmental Protection and approved for permit extension.
- **Project Manager and Technical Lead–Pilot Study and Full-scale Reuse Program; ChevronTexaco; Richmond, California.** This water quality effort included agricultural reuse of approximately 11 million gallons of processing rinse water from a former nitrogen fertilizer manufacturing facility. The processing rinse water was registered with the State of California Department of Food and Agriculture as an agricultural mineral and labeled as Nitro One. Nitro One contains approximately 4 percent total nitrogen. A pilot study was conducted on a cooperating farmer's land that evaluated the effects of different application rates, injection protocols, and handling techniques on corn production. A public relations campaign was conducted to educate the area farmers about the benefits of using Nitro One and the management considerations of the product.
- **Project Manager and Technical Lead–Coalbed Methane Produced Water Discharge and Irrigation Suitability; Petroglyph Operating Company; La Veta, Colorado.** Dr. Kimmelshue evaluated the suitability of highly concentrated sodium-rich water from a coalbed methane operation for discharge and irrigation to corn and alfalfa near Walsenburg, Colorado. This work involved evaluating soil and water amendments to compensate for the high sodium concentrations. This challenging project involved public presentations at local community forums as well as ongoing collaboration with Colorado State University and the Colorado Cooperative Extension Service.

- **Technical Lead–Nutrient Management for the City of Los Angeles Biosolids Land Application Farm; City of Los Angeles Bureau of Sanitation; Bakersfield, California.** Over the past 8 years, Dr. Kimmelshue has been the lead technical consultant for the City of Los Angeles biosolids land application program at Green Acres Farms. This project involved a multitude of nutrient management programs and land application recommendations including irrigation, crop and overall farm management (including a Comprehensive Farm Management Plan) for the 5,000-acre site. The farm receives and beneficially reuses Class A biosolids from multiple municipal treatment plants in the Los Angeles Basin. Recent work involved the refinement of soil and plant tissue monitoring plans, a phased soil amendment schedule, crop fair market value assessment, and customized biosolids database and agronomic loading rate calculation tool Cybersolids™ for use at Green Acres Farm.
- **Technical Lead–Feasibility Study to Determine the Chemical and Hydraulic Effects of Irrigating 420,000 Gallons per Day of Saline Wastewater to an 80-acre Orchard and 75 Acres of Landscaping; IBM; San Jose, California.** This evaluation included a detailed cost estimate of modifying the existing irrigation system and management plan to accept the reuse irrigation water. It also included a comprehensive water quality evaluation that reviewed different blending ratios to ensure adequate water quality according to plant species receiving this irrigation water.
- **Technical Lead and Manager–Clark County Water Reclamation District Biosolids Management Study: Market Assessment; Las Vegas, Nevada.** This effort included a diverse evaluation of potential end-use for Exceptional Quality (EQ) biosolids (in pelletized and bulk form) in the Las Vegas area for the Clark County Water Reclamation District. A key end-use included land application to alfalfa in an arid environment. The end result included recommendations for loading, crop rotations, soil sampling and analysis, tissue sampling and analysis, and potential economic return.

Select Representative Projects – International Work

(Complete work experience includes efforts in the countries of: Turkey, Malaysia, Germany, Egypt, Israel, Jordan, and The West Bank) Representative projects listed here include:

- **Project Manager and Technical Lead–Development of a Reuse Feasibility Assessment for Irrigation of Conventionally Treated Wastewater; Adana, Turkey.** This project was stimulated by the need to conserve on-base water supplies at the Incirlik Air Base. The feasibility study evaluated the needs associated with the conversion of some on-base irrigation water sources from potable water to treated wastewater. This \$100,000 project limited the reliance on off-base water supplies through irrigation with treated wastewater and other conservation practices associated with landscape and crop irrigation. The use efficiency was maximized in this project because storage was limited. A nutrient and hydraulic management plan was constructed for this work to ensure that no over-application of treated wastewater takes place.
- **Project Manager and Technical Lead–Development of Evaluation Strategy for Agricultural Reuse at 19 Wastewater Treatment Plant Sites throughout the Country of Jordan; Amman, Jordan.** These efforts included a technical strategy development for agricultural reuse for the currently operating 19 wastewater treatment plants in Jordan. This involved an evaluation of influencing factors such as soils, climate, and crop production in the area, market conditions, cultural acceptance, wastewater quality, and crop recommendations. The technical report was used to preliminarily prioritize agricultural reuse development for specific areas.

- **Technical Lead–Development of a Feasibility Assessment for Agricultural Reuse of Treated Wastewater for the Hebron Wastewater Treatment Plant Improvements Project; Hebron, West Bank.** This project involved initial development and site location options for reuse of treated wastewater from the anticipated wastewater treatment plant serving Hebron and surrounding communities. Four main sites were evaluated according to land suitability; climatic regimes; proximity to markets; available land area; wadi discharge, potential storage areas and sizing; and impacts to the surrounding environment. Preliminary hydraulic and nutrient balance modeling was conducted for each site and for projected increases in treated wastewater production. This included development of water and nutrient balances for agricultural reuse with local cropping patterns.
- **Technical Lead–Development of a Master Planning Document for the Hebron Wastewater Treatment Plant Improvements Project; Hebron, West Bank.** This project involved a detailed hydraulic and nutrient loading modeling effort for the agricultural reuse component initially proposed in a previous Feasibility Assessment effort. This work was a component of an overall wastewater master planning effort and was driven by environmental and economic concerns of the region.
- **Technical Lead–Development of a Feasibility Study for the Mafraq Wastewater Treatment Plant Improvements Project; Mafraq, Jordan.** This project involved development of water and nutrient balances for beneficial agricultural reuse of treated wastewater based on various scenarios of different cropping patterns, storage sizing, and wadi discharge for forecasted wastewater flows to 2025. Managing climatic influences and the seasonality of application were optimized to maximize the land base available for application.

Previous Experience

Before co-founding Land IQ, LLC, Dr. Kimmelshue spent over 11 years with CH2MHILL. During that time, Dr. Kimmelshue was the firm-wide leader for Agricultural Services Technology, which represented nearly 70 people throughout the firm. Dr. Kimmelshue was also the Business Development Lead for all water resources related projects for a 7-state southwestern region. Prior to that, Dr. Kimmelshue worked as a research associate at North Carolina State University and managed portions of an irrigated agricultural farm in northern California, producing a variety of tree, field, and row crops.

Professional Responsibilities and Accomplishments

State Committee Member – California Department of Food and Agriculture – Specialty Crop Block Grant Advisory Committee – A 6-year appointment for review and selection of proposals for up to \$16M in United States Department of Agriculture funding annually. Sacramento, CA

Fellow – California Agricultural Leadership Program – Class 37 – a 2-year, intensive leadership development program designed for the advancement of current and future leaders in California agriculture. Sacramento, CA

National Committee Member – American Society of Agronomy Career Placement and Professional Development, Minneapolis, MN

Participant – California Water Education Foundation Tours – Sacramento Valley and Central Valley Tours.

Board Chair and Member – Advisory Board for California Polytechnic State University Earth and Soil Sciences Department, San Luis Obispo, CA

Board Member – Advisory Board for California State University Geosciences Department, Chico, CA
Board Member – Shasta Land Trust, Redding, CA

Select Publications

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder, C. Stall, M. Twietmeyer, G. Ludwig, R. Klein, C. Eidsath, G. Obenauf. 2016. California Statewide Crop Mapping for Resource Management and Regulatory Compliance. Manuscript in Development. To be submitted to California Agriculture.

Ludwig, G., D. Hunter, J. Kimmelshue, M. Heilmann, Z. Wang, S. Mulder, C. Stall, M. Twietmeyer. 2016. Development of a Statewide Spatial/Mapping Database for Almonds, Walnuts, and Pistachios – Final Report. California Department of Food and Agriculture/United States Department of Agriculture – Specialty Crop Block Grant Program. USDA Project No. 26235.

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder, M Twietmeyer, R. Spell, C. Stall. 2015. Statewide Tree Crop Mapping of Dried Plums. California Dried Plum Board – Research Reports 2015.
<http://ucanr.edu/repository/fileaccess.cfm?article=160095&p=BSKEQB&CFID=164917629&CFTOKEN=87232494> .

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder, M Twietmeyer, R. Spell, C. Stall. 2015. Statewide Walnut Tree Crop Mapping and Age Determination. California Walnut Board Research Committee – Annual Research Report.

Kimmelshue, J., Z. Wang, M. Heilmann, S. Mulder, C. Stall, R. Spell, G. Ludwig, R. Klein, D. Balint. 2015. Development of a Statewide Spatial Database for Walnuts, Almonds, and Pistachios. Almond Board of California Final Research Report. 14-STEW CROP4-Kimmelshue. Almond Board of California 2014.2015 Annual Research Report. <http://www.almonds.com/growers/resources/research-database> .

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder, M Twietmeyer, R. Spell, C. Stall. 2015. Statewide Pistachio Tree Crop Mapping and Age Determination. California Pistachio Research Board – Annual Research Report.

Kimmelshue, J., D. Smith, Z. Wang, S. Tillman. 2013. Mapping Spatial Distribution of Almonds Using Remote Sensing – Enhancements of Existing Methods and Product for Applications. 12-STEW CROP4-Kimmelshue. Almond Board of California 2012.2013 Annual Research Reports.
<http://www.almonds.com/growers/resources/research-database> .

Kimmelshue, J., D. Williams, S. Tillman, T. DeJong, W. Salas. D. Smart. 2012. Remotely Sensed Determination of Orchard Removal Biomass – Assess Carbon Sequestration Potential of Applying Chipped Almond Prunings to the Orchard Floor. 11-STEW CROP4-Kimmelshue. Almond Board of California 2011.2012 Annual Research Reports. <http://www.almonds.com/growers/resources/research-database>.

Select Presentations

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder, M. Twietmeyer, C. Stall. 2016. Statewide spatial mapping of almonds, walnuts, pistachios, and dried plums in California – results, interpretations, and applications. Featured Scientific Seminar. Invited for Presentation to the International Nut and Dried Fruit Council (INC) XXXV World Nut and Dried Fruit Congress. May 31, 2016. San Diego, CA.

Kimmelshue, J., M. Heilmann, Z. Wang. 2016. Results of Statewide Spatial Almond Mapping and Applications: Acreage, Age Determination, Recharge Suitability, Crop Change. Board of Directors for the Almond Board of California. April 12, 2016. Modesto, CA.

Stall, C., Z. Wang, S. Tillman, J. Kimmelshue. 2016. DWR Cold Water Rice Project Update and Introduction to a Web-Based Information System. Western Canal Water District and Richvale Irrigation District Grower Meeting. March 24, 2016. Richvale, CA.

Heilmann, M., J. Kimmelshue. 2016. 2015 Delta Land Use Mapping. In conjunction with Comparative Study of Methods for Measuring Consumptive Use of Water in the Delta. Office of the Delta Watermaster, State Water Resources Control Board. March 17, 2016. Sacramento, CA.

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder, M. Twietmeyer, C Stall. 2016. Remote Sensed Evapotranspiration Estimates and Crop Mapping within the Sacramento/San Joaquin Delta and Beyond. University of California, Division of Agriculture and Natural Resources – UC Davis Evapotranspiration Remote Sensing Workshop. February 10, 2016. Davis, CA.

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder, M. Twietmeyer, C. Stall. 2016. Results of Statewide Spatial Tree Crop Mapping and Applications: Acreage, Age Determination, Recharge Suitability, and Crop Change. American Society of Agronomy – California Chapter Annual Meetings. February 2, 2016. Visalia, CA.

Heilmann, M., J. Kimmelshue, M. Twietmeyer. 2015. Groundwater Recharge Suitability – Statewide Almond Production. The Almond Conference. December 5, 2015. Sacramento, CA.

Kimmelshue, J., M. Heilmann, Z. Wang, S. Mulder. 2015. Statewide Dried Plum Mapping – Final Results. California Dried Plum Research Committee. December 16, 2015. Sacramento, CA.

Kimmelshue, J., M. Heilmann, M. Twietmeyer. 2015. Almond Groundwater Recharge Suitability. BOD Reputation Management & Agriculture Issues Management (AIM) Taskforce. November 2, 2015. Modesto, CA

Heilmann, M., J. Kimmelshue, Z. Wang, S. Mulder, C. Stall, M. Twietmeyer. 2015. Walnut Mapping and Groundwater Recharge Suitability. Walnut Board of California. December 1, 2015. Folsom, CA.

Kimmelshue, J., M. Heilmann. 2015. Crop Mapping Progress Overview and Update. California Department of Water Resources. October 30, 2015. Sacramento, CA.

Stall, C., Z. Wang, J. Kimmelshue. 2015. Conventional and Wild Rice Mapping Statewide. California Wild Rice Advisory Board and Researchers. July 13, 2015. Yuba City, CA.

Heilmann, M., J. Kimmelshue, Z. Wang. 2015. Remotely Sensed Land Use Applications in Agricultural Systems. United States Congress on Irrigation and Drainage Technical Meetings. June 4, 2015. Reno, NV.

Kimmelshue, J., M. Heilmann, S. Mulder, C. Stall, Z. Wang. 2014. Preliminary Conclusions of Statewide Crop Mapping of Almonds. The Almond Conference. December 10, 2014. Sacramento, CA.

Kimmelshue, J., M. Heilmann. 2014. Results of Remote Sensing for Crop Identification – Citrus. Citrus Research Board and California Citrus Mutual. November 17, 2014. Visalia, CA

Kimmelshue, J., S. Mulder, M. Heilmann, S. Tillman. 2014. An Introduction to Scientific Approaches for Implementation of Future Regulations – A Spatial Approach. California Citrus Showcase. March 6, 2014. Visalia, CA.

Kimmelshue, J., M. Heilmann, Z. Wang. 2014. Results of Remote Sensing of Tree Crops. California Pistachio Research Board. January 30, 2014. Fresno, CA.